Final Plan Attachment 9.5

Inflation Compensation – Addendum to September Report

A Report by CEG

14 December 2016

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Memorandum

To:	AusNet Services, Multinet Gas and AGN
From:	CEG – Asia Pacific
Date:	14 December 2016
Subject:	**Inflation compensation – addendum to September report**

1. This memorandum provides supplementary analysis to our September report for AusNet Services, Multinet Gas and AGN.[1] Section 1 provides a summary of the academic literature that was referred to by the AER in its Final Decision for AusNet distribution in support of the potential existence of bias in breakeven inflation (our original report was limited to those papers discussed by the AER in Table 3-25). It concludes that of the overwhelming evidence in those papers is that any such bias is likely to be positive (such that breakeven inflation overstates expected inflation).

2. Section 2 addresses the optimal regulatory design to give effect to the objective of accurately compensating for efficient financing costs. It begins by recapping how the regulatory regime delivers realised returns to investors and explains why the operation of the PTRM and the RAB RFM must be analysed jointly for this purpose.

3. Section 2 goes onto explain that application of the AER's PTRM and RAB RFM will, absent any cost pass through for the impact of unexpected inflation, cause compensation to systematically deviate from efficient costs when there is a divergence between actual and previously expected inflation. It is explained that this is because the AER's proposed framework treats all financing costs as real (i.e., varying with inflation) but, in reality, efficient debt financing costs are nominal. Amendments to the AER's regime are suggested that would mean that compensation matched benchmark efficient costs even in the presence of unexpected inflation.

4. In this context we agree with the AER that the cost of equity is a real cost and should be compensated as such by deducting the expected inflation that is built into nominal 10 year CGS yields during the equity averaging period. However, we explain that, given that debt is a nominal cost, a different approach is appropriate for debt.

[1] CEG, Best estimate of expected inflation, September 2016.

1 Bias in breakeven inflation

1.1 AER cited literature supports, if anything, a positive estimate of bias

5. In our September report we analysed, *inter alia*, academic papers referred to by the AER (in Table 3-25 of its AusNet Services final decision) in support of the existence of bias. We revisit that analysis below, adding papers referred to elsewhere by the AER in the same decision.

6. In total the AER cites 9 academic papers[2] that deal with the existence of potential sources of bias in breakeven inflation estimates. Of these, only 6 have actual estimates of the sign of any net bias with the focus of the other 3 papers being elsewhere (and generally simply mentioning the theoretical potential for bias). Five of the six papers with empirical estimates present evidence consistent with the conclusion that 10 year breakeven inflation was more likely to overestimate expected inflation than underestimate it. The only paper with the opposite conclusion (Shen and Corning (2001)) relates only to the first four years of the operation of the US indexed bond market.

[2] These references can be found in footnotes 600, 601, 602, 603, 604, 605, 610 611, 613, 614, of the AusNet Distribution Final Decision, Attachment 3, at pages 3-156 to 3-3-159.

Table 1: Literature summary

Finding	Article references
Magnitude and sign of potential bias – discussed in detail in Appendix A	
Positive net bias (overestimation)	Grishchenko and Huang (2012); Finlay and Wende (2011); D'Amico, Kim and Wei (2009); Gurkaynak, R., Sack, B., Wright, J. (2010); Campbell, Shiller and Viceira (2009).
Negative net bias (underestimation)	Shen and Corning (2001). This paper only had 4 years of data available from the first issuance of indexed bonds (see page 68).
No estimate of bias provided	Scholtes (2002) - While not providing any estimates of potential bias in long term breakeven rates, Scholtes states on page 74: "Breakeven inflation rates are useful in providing an indication of investors' views of the longer-term inflation outlook that is unavailable elsewhere." Barnes, Bodie, Triest and Wang (2015) - The authors raise potential sources of bias (at page 70) but make no attempt to measure these. Devlin and Patwardhan (2012) - The authors note the existence of potential sources of bias but do not attempt to measure them.
Sources of potential bias – discussed in detail in Appendix B	
Convexity bias	Grishchenko and Huang (2012), at page 18, cite literature that puts this bias at less than -1bp.
Inflation risk premium	Grishchenko and Huang (2012), at page 30 state that their preferred estimate of inflation risk premium is +14bp to +19bp over the period 2004 to 2008 and also survey the literature which typically estimates a higher inflation risk premium.
Liquidity premium	Grishchenko and Huang (2012), at page 3, estimate the average liquidity premium at 6bp (less than the average inflation risk premium implying the net effect is that breakeven inflation overestimates inflation expectations). D'Amico, Kim, and Wei (2009), at page 64, similarly show a time series for the liquidity premium which has hovered around zero since 2004. Devlin and Patwardhan (2012), at page 8, note that the Australian "relative liquidity difference appears to have narrowed over recent years". Campbell, Shiller and Viceira (2009), at page 115, state that indexed bonds are "extremely cheap to trade".
Impact of indexation lag	The literature notes that the impact of indexation lag is predominantly an issue for short term measures of breakeven inflation: D'Amico, Kim, and Wei (2009), at page 36; Shen and Corning (2001), at page 86, in footnote 29; Scholtes (2002), at page 70. In any event, the sign of any bias is indeterminate.

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1.2 No adjustment for bias previously made by the AER

7. It relevant to note that, when using breakeven inflation to determine expected inflation prior to late 2008, the AER and its forerunner the ACCC, did not make any adjustments for inflation risk or any of the other potential sources of bias, for which it now argues adjustments must be made.[3] Following submissions, including by the author of this report that, at that time, breakeven inflation was upward biased by a lack of supply of indexed CGS, the AER in its 2007 Final Decision for Powerlink stated:[4]

> *The use of the Fisher equation to derive inflation forecasts is a well established practice among Australian regulators. It has been widely accepted as an appropriate method of forecasting inflation. The AER considers that until a thorough analysis of NERA's study has been undertaken, the forecast inflation rate used in revenue caps should continue to be determined by the difference between nominal and indexed CGS yields obtained from the financial market. The use of the latest market based data is objective and transparent and avoids the need for assumptions regarding future inflation. The inflation forecast derived from the Fisher equation also maintains consistency with other financial parameters used in the regulatory framework. Accordingly, the AER considers that its inflation forecast of 3.15 per cent in the draft decision is consistent with the capital market conditions that applies when the CGS yields were sampled.141 For this final decision, the AER has decided to apply a forecast inflation rate of 3.15 per cent per annum based on market determined nominal and indexed CGS yields.*

1.3 Breakeven inflation in 2007

8. There are two important points to note in relation to the experience with breakeven inflation around 2007. The first is that breakeven inflation was widely accepted to be overstating expected inflation (including in subsequent AER decisions). That is, breakeven inflation was accepted as being biased upwards.

9. For a period the AER made no adjustment for this bias but, when it eventually did, it adopted an estimate of expected inflation that was *lower* than breakeven inflation. That is, consistent with adjusting for an *upward bias* in breakeven inflation. This is entirely consistent with the academic literature which suggests that breakeven inflation tends to, if anything, overstate expected inflation.

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3 For example, see ACCC, Final Decision, NSW and ACT Transmission Network Revenue Cap, TransGrid 2004–05 to 2008–09, p. 139.

4 AER, Powerlink Final Decision, 2007, p. 105.

10. This was entirely appropriate in 2007 when the indexed CGS were in short supply and the Government policy was not to issue any new indexed CGS. At that time there were only 3 indexed bonds on issue with maturity horizons of 2, 7 and 13 years.[5] Currently, there are 7 indexed CGS on issue[6] with maturity horizons from 2 to 24 years and a firm Government commitment to continue issuance.[7]

11. Devlin and Hardin (2012), one of the papers cited by the AER, states:[8]

> *The issuance of Treasury indexed bonds was halted in 2003, and maturing bond lines saw the market shrink to a low of around $6 billion outstanding in 2008. In late 2009, however, the AOFM resumed its indexed bond issuance program and the market has since grown to just over $16 billion outstanding. At the 2011-12 Budget the Government announced it would support liquidity in the indexed bond market by maintaining around 10 to 15 per cent of the total CGS market in indexed securities. There are currently five indexed bond lines on issue, with maturities ranging from 2015 to 2030.*

12. Since then the issuance of indexed CGS has expanded still further (indeed doubled in dollar value). This is illustrated in Figure 1 below.

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5 Treasury Indexed Bonds numbered 404, 405, 404. As set out in RBA table F16 Indicative Mid Rates Of Selected Australian Government Securities (available on the RBA website).

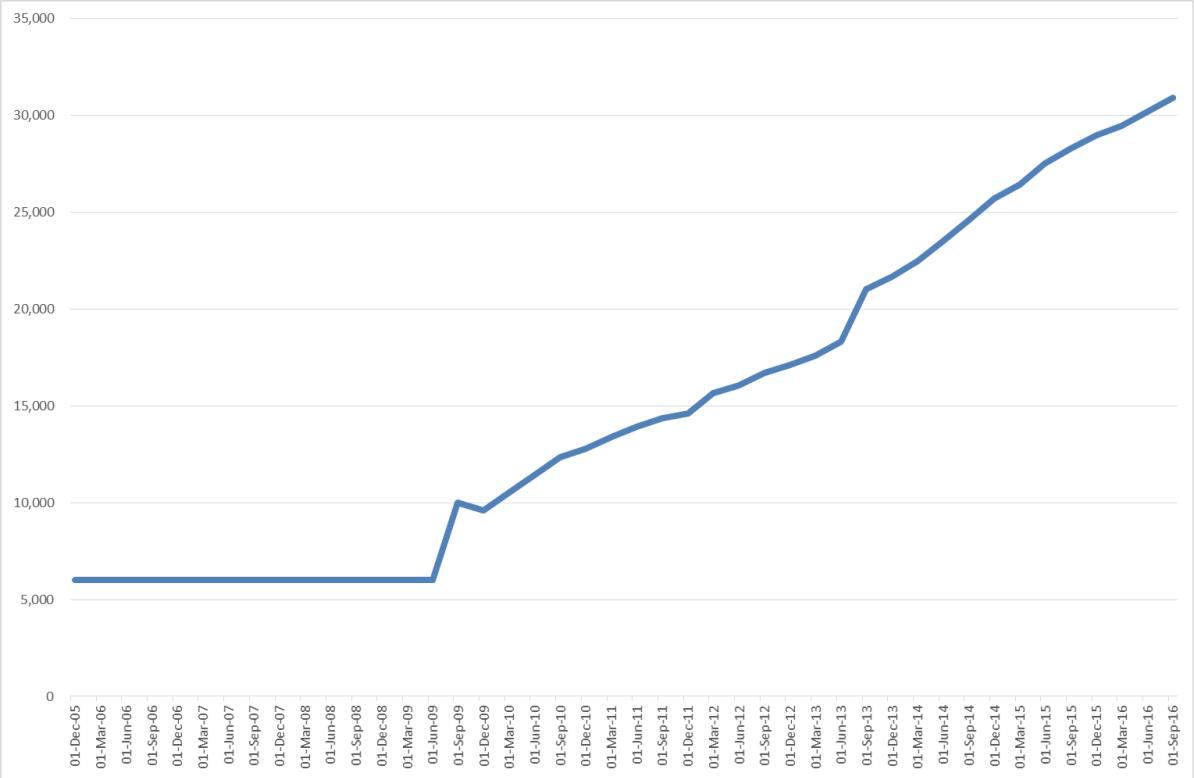
6 Treasury Indexed Bonds numbered 406, 407, 408, 409, 410, 412, and 413. As set out in RBA table F16 Indicative Mid Rates of Selected Australian Government Securities (available on the RBA website).

7 In a 26 May 2015 speech "*Australian Government Sovereign Debt: Are we there yet? What more can be expected in terms of developing the market? – Presentation to the Australian Business Economists luncheon*" the CEO of the AOFM stated:

> *From a modest starting point in 2009 when we recommenced indexed issuance (with $6 billion on issue spread across 3 lines), we now have around $27 billion in stock outstanding ($33 billion when adjusted for inflation indexation). This is spread across 7 lines with a curve extending 20 years.*

8 Devlin and Hardin (2012), p. 8.

Figure 1: Indexed CGS on issue



AOFM data, CEG analysis

13. In relation to the market imperfections in and around 2007 and 2008, the AER refers to two reports authored by the author of this report (Dr Hird for NERA and CEG in 2007 and 2008 respectively).[9] In these reports, it was observed that a lack of supply in indexed government bond yields were, at that time, causing breakeven inflation to *overestimate* expected inflation.

14. As is clear from the findings in the literature relied on by the AER and from Dr Hird's 2007 report, the effect of any inflation risk premium is to render breakeven estimates of inflation expectations *conservative* in that breakeven inflation overstates true inflation expectations, and any adjustment for this issue would lower the estimate of inflation expectations below breakeven inflation. This is made clear in the below quote from Dr Hird's 2007 report:

> *It is important to note that the bias in CGS examined here is a separate issue to any inflation risk premium. An inflation risk premium exists where investors require more than just expected inflation to compensate them for the exposure to inflation associated with nominally defined debt repayments. ...*

9 NERA, Bias in Indexed CGS Yields as a Proxy for the CAPM Risk Free Rate, March 2007; CEG, Expected inflation estimation methodology A report for Country Energy, April 2008.

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That does not mean to say that there is no inflation risk premium. Our work is not intended to shed any light on that issue one way or the other.

15. Any failure to adjust for bias by lowering the estimate of inflation below breakeven inflation can, in no way, provide a rationale for the AER's preference for its own (higher) estimate.

1.4 Estimates of bias are not reliable especially over short windows

16. In order to make an adjustment for bias in expected inflation, one needs to have at hand a better, more accurate, measure of expected inflation. If such a measure was at hand then, obviously, it would be used in preference to breakeven inflation. In other words, all estimates of bias (positive or negative) in the breakeven rate must ultimately be based on a comparison to an alternative measure of expected inflation that is assumed to be more accurate.

17. The alternative estimates used in the literature are commonly surveys of economist forecasts, actual inflation outcomes or some sort of model that defines inflation expectations in terms of past inflation and real economic activity. Grishchenko and Huang (2012) use all three alternative measures.[10] Naturally, the results are only a true measure of bias if it is the case that the alternative measure of expectations is accurate. If the alternative estimate is not accurate, then the results can reasonably be interpreted as bias in the alternative measures of inflation expectations and not in breakeven inflation.

18. Importantly, our September 2016 report carefully explains that surveys of inflation forecasts are typically measures of 'likely' inflation while market based measures reflect actuarially expected inflation. We also explain that the expected inflation that must be used in the PTRM (and which is built into observed bond yields) is actuarially expected inflation. Actuarially expected and most likely inflation can, and do, diverge. Therefore, when a research paper identifies a 'bias' in a market based measure of inflation expectations (such as breakeven inflation) relative to survey inflation expectations this is not necessarily (or even likely) a measure of bias relative to the inflation expectation that the AER should be targeting. Rather, it is just as likely a measure of bias in survey inflation relative to the measure that the AER should be targeting.

19. In our view, in a mature indexed government bond market where ongoing supply is not in question, there is no alternative measure of actuarially expected 10 year inflation expectations built into government bond rates than the breakeven inflation implied by government bond rates. Given that the purpose of inflation expectations in the PTRM is to back out the former measure of inflation expectations, then the latter source of that estimate is best. It is possible that this will be a biased measure but it is not

[10] See discussion beginning in the second paragraph on page 9

possible to reliably estimate the magnitude of any bias over a short horizon (such as a cost of equity averaging period).

20. These considerations are, presumably, why the AER did not make any attempt to adjust breakeven inflation in its 2007 decision for Powerlink quoted above. Namely, having failed to determine a better estimate the AER did not have a reliable basis upon which to make an adjustment.

21. It is, however, possible to, more reliably, arrive at estimates of the average bias over longer periods of time. That does not mean that all such measures will be accurate because, as already discussed, any measure of bias is only as good as the alternative expectation estimate used. However, it is notable that the literature is clear that the best estimate of any such bias is positive (i.e., breakeven inflation is biased upwards).

1.5 Government issuance of indexed bonds implies they believe any bias is positive

22. An important confirmation of the existence of a positive bias is the very existence of CPI indexed bonds. If the bias was negative then this is just another way of saying that CPI indexed bonds are expected to be a more costly form of borrowing by the government in question. The Australian Government's decision to cease issuing indexed CGS in the mid 2000s was based on a projected dwindling of Government debt (due to prolonged budget surpluses) such that even the nominal CGS market was under threat of closure. The cessation of issuance of indexed bonds (and Treasury Notes) reflected the need to concentrate the limited issuance available (at that time) in a single market in order to maintain that market's overall viability.[11]

23. However, as soon as budgetary circumstances allowed, following the GFC, the Government recommenced issuance of indexed CGS. The fact that the Government did so is evidence that it believed that the expected cost of issuing indexed CGS was, at a minimum, not higher than the cost of issuing nominal CGS. By definition, this can only be the case if break even inflation exceeds (or is not less than) actuarially expected

[11] As noted in the 2002-03 AOFM Annual Report

"The Government publicly reviewed the future of the Commonwealth Government securities market during the year against a backdrop of financial market concern about the future viability of the market. The review concluded that sufficient Treasury Bonds should be issued to support the Treasury Bond futures market. Without a Treasury Bond futures market, higher costs associated with managing interest rate risk would lead to slightly higher interest rates across the economy.

The outcome of the review, as set out in the 2003 Budget papers, establishes a clear medium-term framework for the AOFM's debt management operations. While recent borrowing and repurchase programs have been structured to a broad objective of maintaining the viability of the Commonwealth Government securities market, programs going forward will be tightly targeted to support the Treasury Bond futures market. Accordingly, the AOFM has suspended"

inflation outcomes. That is, mathematically, the difference in expected costs of issuing nominal and indexed CGS is equal to:

- inflation compensation built into nominal CGS (i.e., breakeven inflation); and
- actuarially expected inflation.

24. If the former exceeds the latter then the expected cost of indexed CGS are lower than nominal CGS and it makes sense to issue indexed CGS. The Australian Government's keenness to return to issuing indexed CGS post GFC provides a useful indication that it believes than any bias in breakeven inflation is likely positive.

25. The same conclusion has been made explicitly in one of the papers relied on by the AER, namely, Campbell, Shiller and Viceira (2009). The key findings of interest in the current context is that indexed bonds (TIPS, "Treasury inflation-protected securities") are lower expected cost precisely because investors in nominal bonds require compensation for risk above and beyond inflation expectations:[12]

> *"Governments should expect inflation-indexed bonds to be a relatively cheap form of debt financing in the future, even though they have offered high returns over the past decade."*

26. Similarly, on page 115, the authors state:

> *"…our analysis implies that the cost of TIPS should be lower than that of Treasury bills ex ante, because TIPS offer investors desirable insurance against future variation in real interest rates."*

1.6 Conclusion

27. We are aware of no evidence from which the AER can reach a positive state of satisfaction that a better forecast than breakeven inflation is possible in the circumstances (the only other possible forecast before the AER being the AER's estimate). In particular, there is no evidence to suggest that potential biases in the breakeven methodology currently exist (on the contrary, the short term accuracy of the breakeven methodology suggests otherwise) or that, if those biases exist, they would result in an underestimate of inflation. Further, as discussed above, there is clear evidence that the AER's methodology results in an upwardly biased estimate even over a 10 year horizon, given that in the current low inflation and low interest rate environment, investor expectations are that there is an asymmetry of risk in inflation being less than the midpoint of the RBA's forecast and target inflation bands over 10 years than exceeding it.

[12] Campbell, Shiller and Viceira (2009), p. 79.

2 Regulatory design issues – eliminating inflation forecast error for the debt portion of the RAB

28. Under the current regulatory design, any deviation of actual from expected inflation results in a corresponding change in the return on the RAB (both real and nominal) paid by customers and received by investors.[13] This means that adopting the most accurate estimate of expected inflation is critical to correctly compensating investors. For the reasons set out above, and in our September 2016 report, we consider that this is achieved by the adoption of breakeven inflation.

29. This section describes reforms to the regulatory design that would have the effect of reducing the potential impact of deviations of actual inflation from expected inflation. Justification for such reform exists absent any disagreement on the best estimate of expected inflation. However, where such disagreement remains these reforms provide a critical means of also defusing such disagreement. This is because these reforms materially reduce, for both investors and customers, the impact of an inaccurate estimate of expected inflation. .

2.1 How the regulatory regime delivers returns to investors

30. Before analysing how inflation is/should be compensated in the regulatory design, it is critical to understand that financing costs are compensated via a combination of both revenues (set in the PTRM) and rolling forward the RAB (in the RAB RFM). That is, the internal rate of return (IRR) actually received on the investment in the RAB must be calculated by reference to:

- The opening RAB in regulatory period T
- The net cash-flows before interest during the regulatory period T; and
- The opening RAB in regulatory period T+1 (i.e., the "Terminal Value" in the cash-flow analysis).

31. Similarly, from the perspective of equity investors (i.e., owners) the IRR must be calculated by reference to:

- The equity portion of the opening RAB in regulatory period T
- The cash-flows *after interest* during the regulatory period T; and
- The equity portion of the opening RAB in regulatory period T+1 (i.e., the "Terminal Value" in the cash-flow analysis).

[13] For any given actual inflation, a 1.0% lower/higher estimate of expected inflation will flow through automatically into a 1.0% higher/lower real return on the RAB.

32. In order to analyse the role of inflation in the regulatory design it is impossible to do so without simultaneously analysing the operation of both the PTRM and the RAB RFM.

2.2 Inflation risk and regulatory design

33. The AER has expressed its view that under the current regime regulated businesses face "no inflation risk"[14] which is less than the risks faced by competitive businesses.

> *Regulated service providers face less inflation risk than unregulated businesses. Under the regulatory framework, they effectively expect to receive a real return on their investments in their RABs and to also have their RABs indexed for actual inflation.*

34. However, the AER conflates maintaining the real value of the RAB with eliminating inflation risk. These two concepts are only the same if all financing costs are incurred in real (inflation adjusted) terms. This is clearly not the case for debt financing costs which are efficiently incurred in fixed nominal contracts (i.e., such that repayments to debt providers are independent of the level of subsequent inflation after the contract is entered into).

35. Given that the benchmark entity has fixed nominal financing costs for 60% of its RAB, maintaining a fixed real return on the RAB creates, rather than eliminates, inflation risk. By way of example, imagine a business with a RAB of $10bn financed with $6bn in debt and $4bn in equity. Now, let a period of unexpected deflation occur such that the price level halves. The RAB would need to halve to $5bn in order to maintain the real value of the RAB. However, total outstanding debt, specified in nominal terms, would remain at $6bn and the benchmark business would be bankrupted ($1bn (or 20%) more debt than gross assets).

36. Similarly, if there was a period of unexpectedly very high inflation, such that the price level doubled, the businesses' debt would remain fixed in nominal terms at 6bn but the value of the assets would double to $20bn – causing the equity stake to more than triple (from $4bn to $14). Given the price level only doubled in this example the equity stake would only need to double to $8bn in order to maintain its real value. The additional $6bn increase in the equity stake is a pure windfall for the equity owners.

37. Neither of these impacts (bankruptcy or a $6bn dollar windfall) is as a result of any inefficient/efficient action taken by the business. Rather, these result from forces that are outside the control of the business, economy wide inflation levels, interacting with a regulatory design that does not accurately reflect the impact of unexpected inflation on costs.

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14 See Final Decision for AusNet distribution p. 3-157.

38. The above examples are extreme in order to provide a clear illustration of the nature of the problem. However, the same effect is produced for smaller divergences between expected and actual inflation. More generally, compensating debt financing costs 'as if' they were real (rather than nominal) costs means that debt costs will be over/undercompensated whenever inflation is higher/lower than the expected inflation used to set the real revenue path.

2.3 Correction if objective is to remove inflation risk

39. If one accepts that debt costs are efficiently incurred in nominal terms, there are a number of ways that this mismatch between efficient costs and compensation can be corrected. All of them involve ensuring that, for the debt funded 60% of the RAB, the revenue reduction associated with inflation is the same as the RAB increase in the RFM. This can be achieved by:

- Retaining the current approach to the 2018-22 PTRM but using a 60/40 weighted average of PTRM/actual inflation in the 2018-22 RAB RFM;
- Retain the current 2018-22 RAB RFM but amend the 2018-22 PTRM such that annual updates of the PTRM correct for 60% of divergences between actual and expected inflation.
- A cost pass through measure corresponding to the difference between nominal compensation actually provided for the cost of debt (via both PTRM revenues and RAB RFM) and the nominal cost of debt (as per the trailing average calculations).

40. Correctly implemented, all of these approaches would have the same result, namely, ensuring that the nominal compensation for the cost of debt matches the nominal cost of debt which is the regulator's best estimate of efficient debt financing costs and which is used as an input to the PTRM.

2.4 Implication for measuring inflation expectations

41. The AER's current approach to inflation forecasting is to forecast inflation over a 10 year horizon where the start date of that horizon is the beginning of the regulatory period.[15] In our view, the adoption of a 10 year horizon only makes sense in the context of attempting to derive a real return on equity. If debt costs are efficiently incurred in nominal terms then the forecast horizon should be the five year regulatory period

[15] This is the AER's practice and it is consistent with the approach described in AER *Final decision, TransGrid transmission determination 2009–10 to 2013–14,* p.64 where the AER states: "The AER has updated the inflation forecast **for the first two years of the next regulatory control period** using the latest published RBA inflation expectations as shown in table 4.5." (emphasis added). The AER references this document in its PTRM transmission handbook as a description of its methodology.

(because this is what maximises the probability that the deduction from revenues for inflation in the PTRM will match the increment to the RAB in the RFM for inflation).

42. However, putting this issue aside, even if the objective was to estimate the expected real return on both equity and debt, then the correct measure of 10 year inflation expectations is the expected inflation in the equity and debt averaging periods. This is the inflation expectation that will be embedded in the bond returns that are used by the AER to set the cost of debt and equity.

43. The averaging periods for debt and equity can be materially different both from each other and from the start of the regulatory period. Indeed, there are 10 different averaging periods for the cost of debt under a trailing average which are spread over 10 different years. There is no reason to believe that inflation expectations for 10 years starting on the first day of the regulatory period has any bearing whatsoever on the inflation expectations built into the nominal cost of debt. It follows that, even if one were interested in removing the inflation expectation built into nominal debt costs, one would need 10 different inflation expectations – one to match each relevant averaging period in the trailing average.

44. Focussing on equity costs, which is the only element of financing costs it makes sense to attempt to remove expected inflation, the required measure is the 10 year inflation expectation that:

    a. is held by investors in the 10 year government bond market;

    b. reflects the same 10 year horizon (starting in the averaging period and ending 10 years hence); and

    c. is measured over the equity averaging period (i.e., over the period that the 10 year nominal government bond yield is measured as an input into the cost of equity).

45. Clearly, 10 year breakeven inflation measured over the regulatory period provides a measure that is consistent with all of these requirements: a) derived from the relevant bond market; b) reflects a 10 year horizon from the equity averaging period; and b) measurable over the equity averaging period. The AER's method does not: a) attempt to measure bond market investor expectations; b) cover a 10 year horizon starting in the equity averaging period; c) reflect an average of expectations during the equity averaging period.

Appendix A: Summary of empirical estimates

46. This appendix summarises the key results of the 6 articles referred to by the AER that have empirical estimates of bias.

Introductory comments

The term 'liquidity premium' does not mean the same thing in all studies

47. Before proceeding with a discussion of each individual paper it is useful to make a few observations about the existence or otherwise of a 'liquidity premium'. The first point to note is that in much of the literature the reported 'liquidity premium' is, in reality, an error term in the analysis. It is the term given to the amount of the difference between nominal and indexed government bonds that is not explained by the other factors in the researchers' models. For example, D'Amico, Kim and Wei (2009) estimate a TIPS[16] "liquidity premium" that causes breakeven inflation to overestimate expected inflation in early 2005[17] (i.e., associated with breakeven inflation overestimating expected inflation). If one attempted to truly relate this back to differential liquidity as a cause it would imply that investors in that period preferred indexed bonds (paid a higher price/accepted a lower yield) because they valued relative illiquidity.

48. There is no reason to believe that investors would pay more for index linked Treasury bonds because they are less liquid. Therefore, there is no reason to assign an upward bias in breakeven inflation that is due to the relative liquidity of the instruments. However, if the liquidity premium is simply the name given to an error term (residual) in the researchers' model then this, naturally, can be negative. Given that many of the papers surveyed use surveys of inflation expectations as the benchmark against which breakeven inflation is measured what is really being measured are potential explanations for why breakeven inflation is different to the average of survey information.

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16 US Treasury Inflation Protected Securities.

17 See Figure 11 of D'Amico, Kim and Wei (2009). The Authors updated (and modified) their estimates for a 2016 published version of the same paper. In that paper the TIPS "liquidity premium" is associated with breakeven inflation exceeding expected inflation from 2012 onwards – as can be seen in the reproduction at Figure 24 of our September 2016 report. (Note that in the 2016 paper the authors have assigned a different sign to the "liquidity premium". In the 2009 paper a negative "liquidity premium" implied upward bias in breakeven inflation while in the 2016 paper a positive "liquidity premium" implies upward bias in breakeven inflation).

Potential for 'true' liquidity premium is small

49. The theoretical reason for the existence of a liquidity premium is that investors will have a preference for assets that are more liquid because those assets allow them to optimise their portfolios at lowest cost. Specifically, a 'liquid' market is one where an individual investor can expect to be able to buy or sell into the market without their personal transaction having a significant impact on the price paid/received in the transaction.

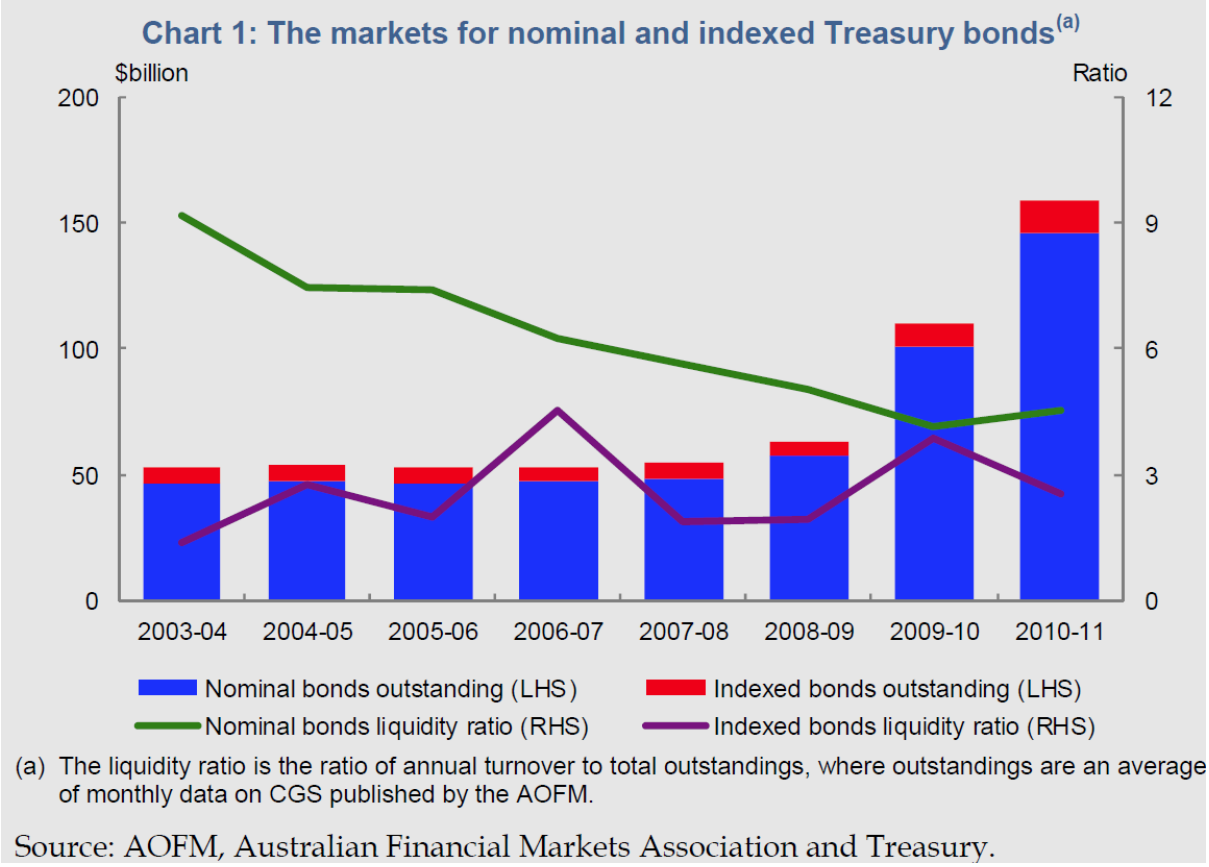
50. In reality, both indexed and nominal CGS are highly liquid. This means that the value investors place on any differential in liquidity is likely to be trivial. Both the nominal and indexed CGS markets are highly liquid with turnover of around $1,000bn and $50bn respectively. While the turnover in nominal bonds is around 20 times larger, both are very large in absolute magnitude.

51. Moreover, liquidity is a function of the ability of an investor to divest their holding without moving the market and, given that investors' holdings on nominal CGS tend to be larger, the absolute turnover must be adjusted for the average holding of these bonds in an investor's portfolio. A standard way to do so is to divide turnover rates by total outstanding stock in order to provide the 'turnover ratio'. The Australian Financial Markets Association produces this metric for nominal CGS and it has fallen from 5.2 in 2007/08 to 3.2 in 2014/15. [18] A similar metric for indexed CGS was around 1.2 in 2007/08 and 2.0 in 2014/15.[19] On this metric, liquidity in nominal CGS is only modestly higher than for indexed CGS. Notably, this is the metric that is used in the Devlin and Patwardhan (2012) when they note on page 8 that "relative liquidity difference appears to have narrowed over recent years". The relevant chart on which this statement is based is produced below.

[18] AFMA, 2008 and 2015 Australian Financial Markets Report.

[19] AFMA does not explicitly present this ratio but it can be calculated as total turnover in index linked CGS (e.g., $51bn in 2014-15) divided by total bonds outstanding available from AOFM ($25.5bn average of beginning and end of year outstanding in 2014-15).

Figure 2: Reproduction of Chart 1 from Devlin and Patwardhan (2012)



52. Notably the AER cites Devlin and Patwardhan (2012) in support of the AER's view that '*the size and liquidity of the indexed CGS market is still limited*'.[20] However, the AER cites to page 7 of Devlin and Patwardhan (2012) in support. On the relevant page Devlin and Patwardhan (2012) make the following statement:

> *The use of bond market break-evens is also made somewhat problematic by the limited size and liquidity of the indexed bond market in Australia. While the market for (nominal) Treasury bonds is quite liquid, the market for Treasury indexed bonds is significantly less liquid (see Box 1).*

53. In our view, this quote, and the reference to Box 1 in which Chart 1 above is found, is clearly referencing historical average differences in liquidity – not prevailing estimates (for which the authors note relative liquidity difference appears to have

[20] AER, Ausnet Distribution, Final Decision, May 2016, p. 3-159.

narrowed over recent years). Moreover, this is before factoring in the increased issuance since publication of the article.[21]

54. Moreover, having cited Devlin and Patwardhan (2012) (incorrectly) in support of a conclusion that '*the size and liquidity of the indexed CGS market is still limited*', the AER goes onto use a measure of relative liquidity which is not that used by Devlin and Patwardhan (2012). Instead, they use absolute trading volume (not volume relative to outstandings).[22]

> *Trading volume of indexed CGS expressed share of total indexed and nominal CGS can be used as a measure of the relative liquidity. According to this metric, there has only been a minor improvement to relative liquidity of the indexed CGS since early 2008.*

55. Even if we were to accept the AER's use of absolute trading volumes as an appropriate measure of absolute 'liquidity',[23] it is critical to differentiate between this measure of liquidity and the value that investors place on liquidity. The AER, in the above quote, proceeds as if the marginal value to investors of liquidity (so measured) does not decline with absolute liquidity. This is a critical theoretical error.

56. Investors' valuation of additional liquidity falls to zero as soon as they are confident that their own trading will not move the market against themselves. That is, if I am already confident that I will not move the CGS market against myself when trading, then I receive no advantage, and will not value CGS any higher, if the turnover in the market doubles or quadruples. Both nominal and indexed CGS are homogenous products that are very easy to value. This means that there are not the same 'inside information issues' that arise with trading corporate equity and debt. This fact, when combined with the very large in size (and turnover relative to size) markets means

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21 Thus, the reference to 'still' in the AER quote, made in 2016, should, at best, be 'was limited in 2010-11'. This is particularly important given that the authors of that paper note (on p. 8) "In late 2009, however, the AOFM resumed its indexed bond issuance program and the market has since grown to just over **$16 billion** outstanding. At the 2011-12 Budget the Government announced it would support liquidity in the indexed bond market by maintaining around 10 to 15 per cent of the total CGS market in indexed securities. There are currently **five indexed bond lines on issue**, with maturities ranging from 2015 **to 2030**." [Emphasis added.] At the time of the AER's final decision there were **seven indexed bond lines** on issue (see AER, AusNet Distribution Final Decision, 2016 3-159) which is 2 more than the five referred to by Devlin and Patwardha. Similarly, the amount outstanding was at least **$33 billion** outstanding (see CEG, report for SAPN, p.7 FN 4) more than double the $16bn in 2010-11 referred to by Devlin and Patwardha. Similarly, the maturity range extended out to **2040 or 2045** (see CEG, report for SAPN, p.7 FN 5) which is 10 to 15 years longer than referred to by Devlin and Patwardha. Moreover, the expanded issuance of indexed CGS was foreshadowed by Devlin and Patwardha in the above quote. The AER's reliance on Devlin and Patwardha to conclude that liquidity of the indexed CGS market is "still" limited is an important factual error.

22 AER, Ausnet Distribution, Final Decision, May 2016, p. 3-159.

23 Indeed, the following logic applies to any measure of liquidity – including turnover adjusted for outstandings.

that it is therefore reasonable to assume that the potential value of incremental increases in turnover/liquidity ratio when moving from indexed CGS to nominal CGS are very small.

57. Contrary to the AER's position, a material absolute increase in turnover for indexed bonds will, even if it is matched by higher turnover for nominal bonds, materially reduce any liquidity bias because the marginal 'liquidity value' of incremental turnover will be higher for the less liquid instrument. In this context it is relevant to note that, Campbell, Shiller and Viceira (2009, p.115) state that indexed bonds are "extremely cheap to trade". Once an instrument is 'extremely cheap to trade' there is a limit to any difference in the cost of trading that instrument and a lower cost instrument.

58. That is not to say that there might be a more material liquidity premium when moving from CGS to less liquid assets (such as corporate debt/equity or real-estate). However, there is no reason to believe that a material liquidity premium exists when moving from indexed to nominal CGS.

Grishchenko and Huang (2012)

59. The relevant finding from Grishchenko and Huang (2012, p. 30) is as follows

> *"…we conclude that the 10-year inflation risk premium ranges between 14 and 19 b.p., depending on the proxy used for expected inflation, based on our empirical analysis and when we correct for liquidity using a liquidity adjustment".*

60. That is, the authors estimate that exposure to inflation risk in nominal government bonds causes these bonds to include a risk premium of 14 to 19bp such that breakeven inflation is overstated (i.e., nominal yields are elevated relative to inflation protected yields).

61. Grishchenko and Huang (2012) also examine the existence of a liquidity premium that might have the opposite effect (raising the relatively less liquid indexed bond yields relative to the nominal bond yields). Figure 4 of Grishchenko and Huang (2012) demonstrates that, from 2000 to 2009, any impact of a liquidity premium on breakeven inflation is below 10bp outside the GFC and a single month in 2003. The authors' average liquidity premium estimate is 6bp (see page 3).

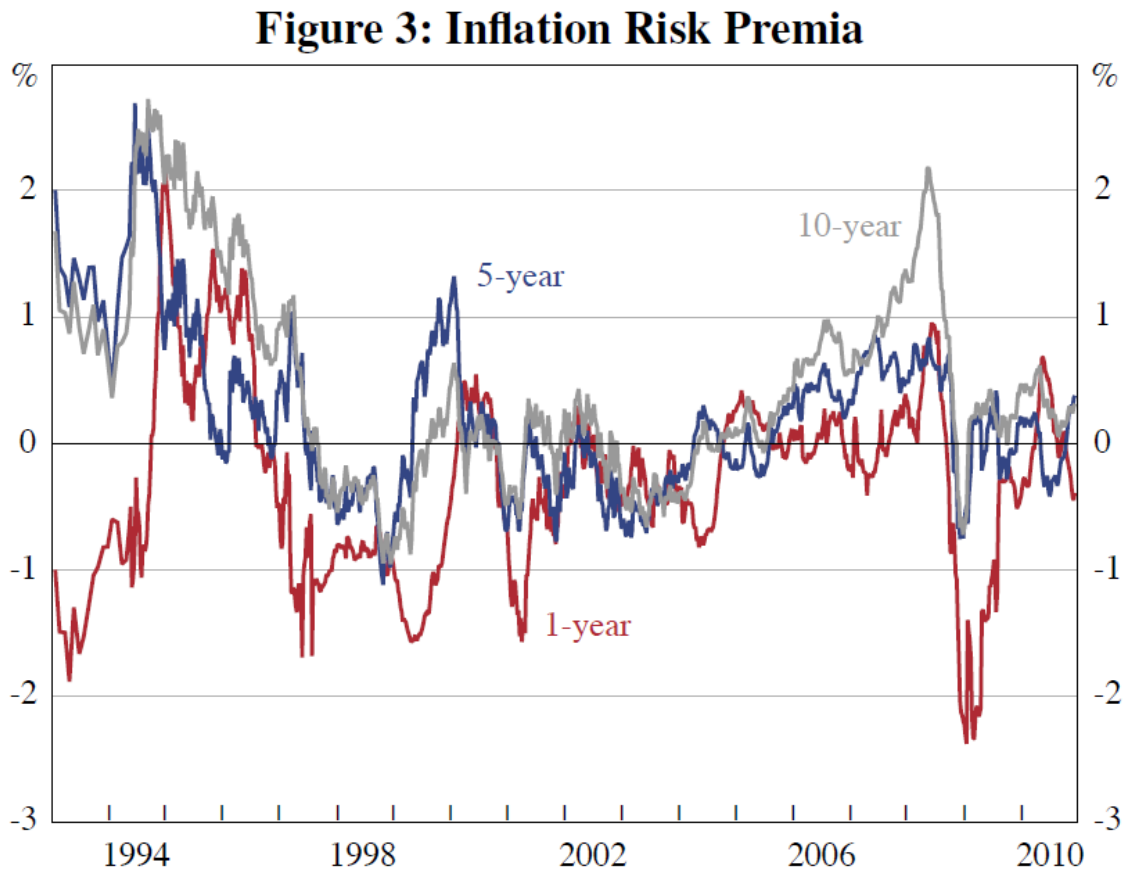
62. Subtracting this from the 14-19bp range gives a net bias estimate of 8-13bp. This implies breakeven inflation overestimates expected inflation by 8-13bp.

Finlay and Wende (2011)

63. The most relevant findings are presented in Figure 3 on page 16, which shows that the inflation risk premia (which incorporates any liquidity premia) for 10 year maturity

(grey line) is positive for the majority of the sample period in Australia and for all of the period post GFC.

Figure 3: Reproduction of Figure 3 from Finlay and Wende (2011)



64. Similar results presented for the UK in the bottom panel of Figure 5 on page 19.

D'Amico, Kim and Wei (2009)

65. The key summary chart is the bottom panel of Figure 11 on page 64 which shows that, since 2003, the 10 year breakeven inflation has been typically higher than or hovered around the authors' alternative estimate of inflation expectations.

Figure 4: Reproduction of Figure 11 from D'Amico, Kim and Wei (2009)

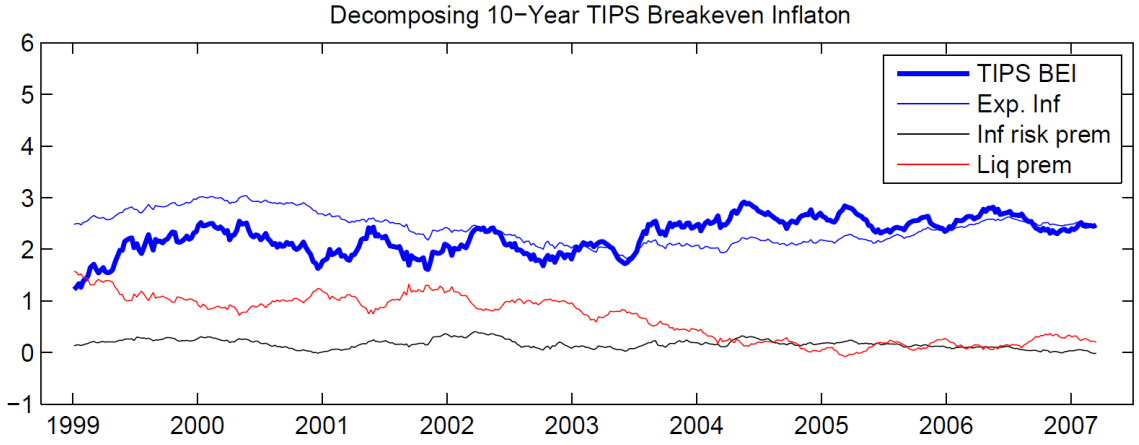
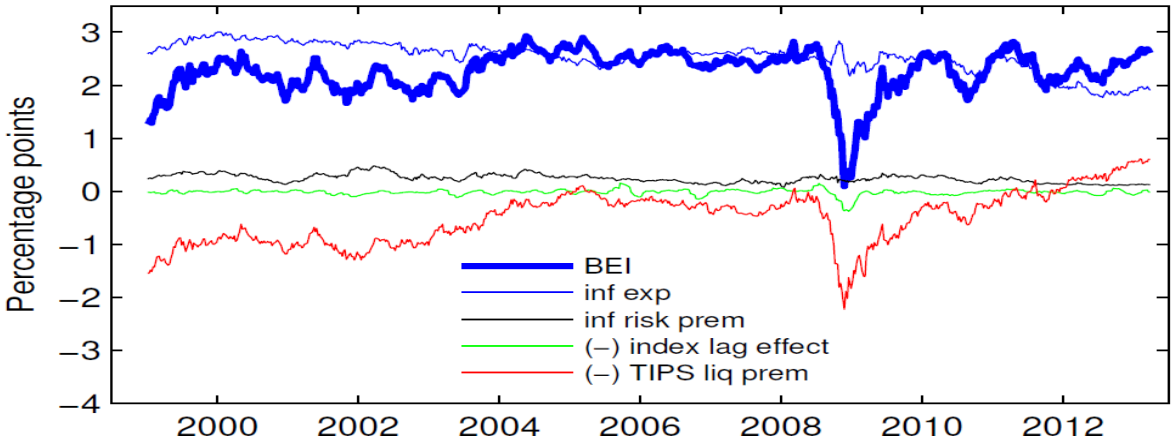


Figure 11: Decomposing TIPS Yields and TIPS Breakeven Inflation

66. As noted in our September report, the same authors have a 2016 update[24] which shows that, but for the GFC, the same results held.

Figure 5: Decomposing 10-year TIPS Breakeven Inflation D'Amico, Kim and Wei (2016)



[24] D'Amico, S., Kim, D. H., and Wei, M., "Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices," FEDS Working Paper 2014-24 (Draft Version February 19, 2016)

Gurkaynak, R., Sack, B., Wright, J. (2010)[25]

67. Gurkaynak, R., Sack, B., Wright, J. (2010, p. 85) state:

> *"Since 2002, survey expectations have been consistently below inflation compensation, suggesting that the inflation risk premium (which pushes inflation compensation up) now outweighs the TIPS liquidity premium (which pushes inflation compensation down)."*

Campbell, Shiller and Viceira (2009)

68. The authors are primarily concerned with the utility of issuing/holding indexed bonds from the perspective of the government/investors. The key findings of interest in the current context are where the authors state (at page 79) that:

> *"Governments should expect inflation-indexed bonds to be a relatively cheap form of debt financing in the future, even though they have offered high returns over the past decade."*

69. Similarly, on page 115, the authors state:

> *"…our analysis implies that the cost of TIPS should be lower than that of Treasury bills ex ante, because TIPS offer investors desirable insurance against future variation in real interest rates."*

70. TIPS are "Treasury inflation-protected securities." These statements that the costs of issuing TIPS are lower than nominal bonds can only be true if inflation compensation built into nominal bonds is higher than the expected level of inflation (i.e., nominal rates are elevated by an inflation risk premium).

71. The AER (Ausnet distribution Final Decision, page 3-157, in footnote 602) also refers to Campbell and Shiller to the effect that:

> *"Campbell and Shiller also found that with inflation positively correlated with stock prices during the US economic downturn (2009), the inflation risk premium in nominal Treasury bonds is likely negative."*

72. The AER's reference is to page 115 - the same page of Campbell, Shiller and Viceira (2009) where they state that TIPS are lower expected cost to Governments than nominal bonds. That finding, omitted from the AER's analysis, is the most relevant.

73. The AER (AusNet Distribution Final Decision, Attachment 3, page 3-157) argues that the inflation risk premium may be negative if there are fears of deflation.

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[25] The authors state on page 85: "Since 2002, survey expectations have been consistently below inflation compensation, suggesting that the inflation risk premium (which pushes inflation compensation up) now outweighs the TIPS liquidity premium (which pushes inflation compensation down)."

> *However, if there are concerns about deflation, the inflation risk premium may become negative and the breakeven inflation rate may underestimate expected inflation.*

74. The only way that this can be true is if investors in nominal bonds view them as having negative risk (i.e., investors prefer to be exposed to inflation risk via holding a nominal bond than not to be exposed to inflation risk). If this is true then breakeven inflation will tend to underestimate 'pure' expected inflation. However, it also follows logically that the nominal bond rate will be depressed below the true risk free rate by the presence of such negative risk (and by exactly the same amount as breakeven inflation underestimates actual inflation).

75. It follows that, even if this speculative scenario were actually true, the AER must have made an equal and offsetting error in its estimation of the nominal risk free rate – such that using breakeven inflation will arrive at the correct real risk free rate (one that removes the impact of the negative risk premium the AER speculates could be embedded in nominal yields). That is, arguments that imply breakeven inflation is biased because the nominal bond rate has positive/negative risks are, in reality, arguments in favour of the use of breakeven inflation because any bias so created will offset the bias in the proxy for the risk free rate.

Shen and Corning (2001)

76. Shen and Corning (2001) concludes that breakeven inflation tended to underestimate expected inflation in the very early period of the indexed bond market. However, this paper had only had 4 years of data available from the first issuance of indexed bonds (see page 68) and sheds no light on the magnitude of any bias in a mature market for indexed bonds.

Appendix B: Potential sources of bias

77. The AER discusses four different potential sources of bias in breakeven inflation. The AER does not seek to put any value on these. Table 2 summarises what that literature said about those sources of bias.

Table 2: Literature relating to individual sources of bias

Convexity bias	Grishchenko and Huang (2012), at page 18, cite literature that puts this bias at less than -1bp.
Inflation risk premium	Grishchenko and Huang (2012), at page 30 state that their preferred estimate of inflation risk premium is +14bp to +19bp over the period 2004 to 2008 and also survey the literature which typically estimates a higher inflation risk premium.
Liquidity premium	Grishchenko and Huang (2012), at page 3, estimate the average liquidity premium at 6bp (less than the average inflation risk premium implying the net effect is that breakeven inflation overestimates inflation expectations). D'Amico, Kim, and Wei (2009), at page 64, similarly show a time series for the liquidity premium which has hovered around zero since 2004. Devlin and Patwardhan (2012), at page 8, note that the Australian "relative liquidity difference appears to have narrowed over recent years". Campbell, Shiller and Viceira (2009), at page 115, state that indexed bonds are "extremely cheap to trade".
Impact of indexation lag	The literature notes that the impact of indexation lag is predominantly an issue for short term measures of breakeven inflation: D'Amico, Kim, and Wei (2009), at page 36; Shen and Corning (2001), at page 86, in footnote 29; Scholtes (2002), at page 70. In any event, the sign of any bias is indeterminate.